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ABSTRACT

By far, the greatest risk to health from radon occurs when the gas enters the house from underlying soil and is inhaled. The U.S. Environmental Protection Agency (EPA) is studying ways to reduce radon in houses, including methods to remove the gas from water to prevent its release in houses when the water is used. While this research has not answered all the questions about household water treatment systems, current information that may be of immediate use to homeowners is available. This booklet is intended specifically for homeowners who suspect that the water they get from their own well, or water they receive from a water utility that uses well water, may be a significant source of radon in their homes. Discussions include sources of radon in water, testing for radon in water, control methods such as the granular activated carbon filter, and costs associated with radon control. EPA regional offices and state radon contacts are listed. (CW)

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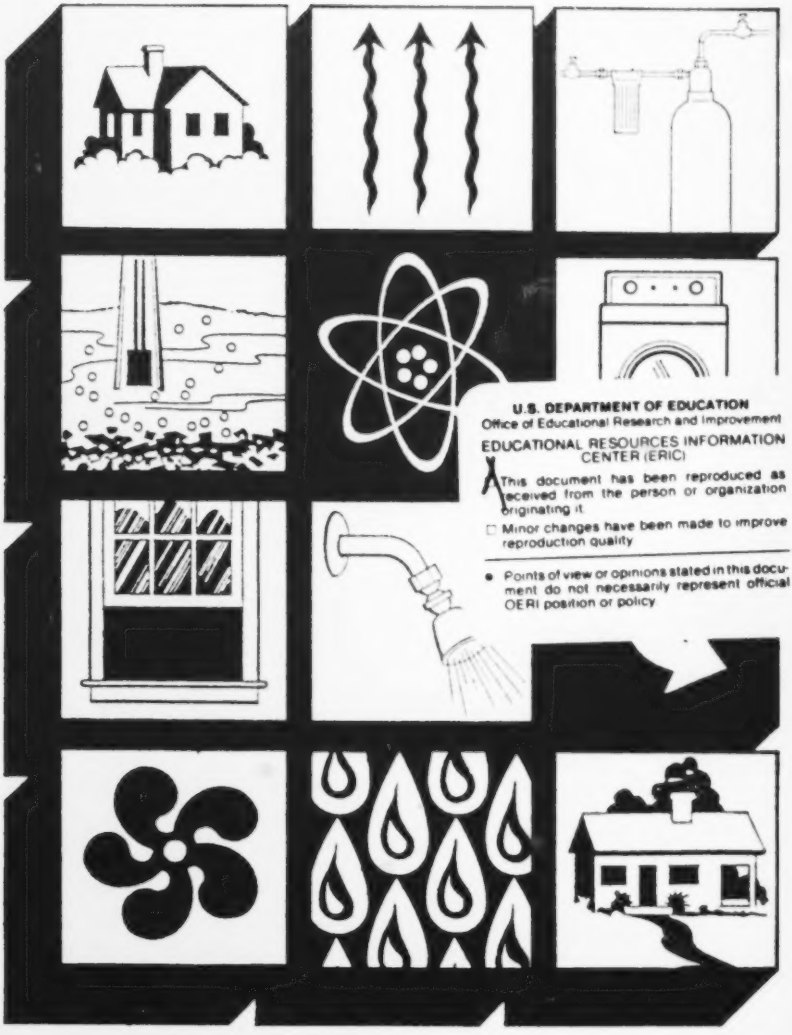
United States
Environmental Protection Agency
Washington DC 20460

September 1987
OPA-87-011

Research and Development

EPA

Removal of Radon From Household Water



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EPA Study

The U.S. Environmental Protection Agency (EPA) is studying ways to reduce radon in houses, including methods to remove the gas from water to prevent its release in houses when the water is used. While this work has not yet answered all the questions about household water treatment systems, we are publishing what information we have that may be of immediate use to homeowners. **This booklet will be revised as additional information becomes available.**

General Information

This booklet is intended specifically for homeowners who suspect that the water they get from their own well, or water they receive from a water utility that uses well water, may be a significant source of radon in their homes.

General information about indoor radon and the evaluation of test results of indoor air is available in the EPA publication *A Citizen's Guide to Radon: What It Is And What To Do About It* [OPA-86-004]. Information about ways of removing radon from household air and preventing radon entry from the soil surrounding your house is presented in the EPA publications *Radon Reduction Methods: A Homeowner's Guide* (Second Edition) [OPA-87-010] and *Radon Reduction in New Construction: An Interim Guide* [OPA-87-009]. To get copies of these booklets, contact your state radon program office. (See list at the end of this booklet.) Generally, the state office that handles radiation health issues is different from the state agency responsible for drinking water quality, including radon. So you should ask to talk with the appropriate agency in your state if you want more information on radon in household water.

The Threat to Health

By far the greatest risk to health from radon occurs when the gas enters the house from underlying soil and is inhaled. As noted in *A Citizen's Guide to Radon*, scientists estimate that from about 5,000 to about 20,000 lung cancer deaths a year in the United States may be attributed to radon from soil. It is also estimated that an additional 100 to 1,800 lung cancer deaths per year (approximately) are caused by inhaling radon emitted by household water.

Radon concentrations in water and in air are measured in picocuries per liter (pCi/L). The lifetime risk of developing lung cancer from household water that contains 1,000 pCi/L of radon is roughly 3 to 13 in 10,000; from water with 10,000 pCi/L of radon, the risk is approximately 3 to 13 in 1,000; for water containing 100,000 pCi/L of radon, the risk is about 3 to 12 in 100.

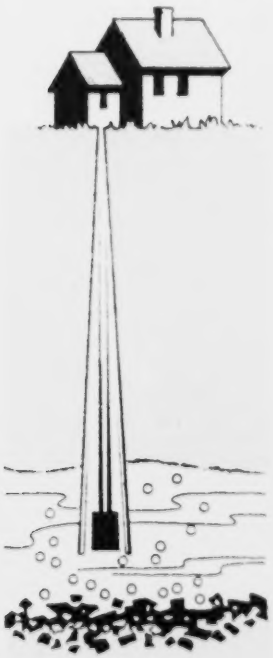
EPA has set drinking water standards for other contaminants at a level equivalent to a risk of 1 in 10,000 to 1 in 1,000,000.

If you regularly **drink** household water containing radon, it is not considered a health risk. Waterborne radon is a problem **only** when the radon is released from the water and enters household air. If there is no measured problem with airborne radon in a home, there generally is no need to test for radon in household water.

Radon in Water

About one-half of the U.S. population relies on underground sources of water, called ground water. Ground water flows through porous soil and small spaces between rocks at a relatively slow rate: only a few feet per year in some areas. When water is pumped out of a well, the flow rate can increase significantly.

Radon, which is formed from natural deposits of uranium, is soluble in water. So radon dissolves into passing ground water. How much radon enters the ground water depends upon the amount of uranium in the ground and the flow rate of the water. The level of radon in ground water is usually less than 1,000 pCi/L; however, in a few cases, levels over 1,000,000 pCi/L have been detected.



Most of the radon will be released from water when the water is exposed to air. Our experience thus far indicates that, as a rule of thumb, there will be an increase of about 1 pCi/L in the air inside a home for every 10,000 pCi/L of radon in the household water. Consequently, a waterborne radon level of 40,000 pCi/L can result—by itself—in an indoor air level of about 4 pCi/L (which is the level at which EPA recommends that remedies should be considered).*

The household water supply, however, is normally not the sole contributor to indoor radon. Usually only a small percentage (on average, 2 to 5 percent) of the radon found in a home comes from household water. Exceptions do occur. For example, in some areas of the northeast and west, high concentrations of radon are found in ground water and may become a significant factor in total indoor radon levels.

The principal means of radon entry into a home is through cracks and other openings in the walls and floors that are in contact with the soil.

Vulnerable Areas

Homes that use surface water instead of ground water will not have a problem with waterborne radon.

While radon is present in most soils and rocks, concentrations high enough to cause problems in ground water have been found, so far, in only a few cases. Even in areas that do have high concentrations of radon in

* Some tests of radon levels in indoor air give the results in Working Levels (WL). Under normal conditions, 1 Working Level (WL) is approximately equal to 200 pCi/L; so the indoor radon level above which EPA suggests taking some action (4 pCi/L) is about equal to 0.02 WL.

the soil, many homes will not encounter a problem with waterborne radon for two reasons. First, when water is supplied by a municipal system, radon is released while the water is being treated in the system. This is true even when ground water is the source of the water supply. Second, radon is transformed (by radioactive decay) into other substances when water is held in storage.

The greatest problems with waterborne radon normally occur in homes which are located in areas with high levels of radon in the ground water and which are served by an individual well or a small community water system (serving up to about 100 homes).

From Water To Air

When water is exposed to the atmosphere, some of the dissolved radon will be released. The amount of radon given off will increase if the water is heated and as the surface area exposed to air is increased. Thus, the largest releases of waterborne radon in the home are due to those activities and appliances that spray or agitate heated water, such as taking showers and washing dishes or clothes.

Since water is used in only a few rooms (bathroom, kitchen, laundry, etc.) at irregular intervals, the amount of radon entering your home from the water will vary dramatically according to room layout and time of day. Your daily patterns of water use (e.g., if the whole family takes showers in the morning or if all the laundry is washed on one day) should be considered when the air in your home is being tested for radon.

Testing The Water

If tests of the air in your home have shown that you have a radon problem (see the "General Information" section above) and you suspect that your household water supply may be a significant cause, you should contact your state agency listed at the back of this booklet to see whether the health department, radiation protection office, or drinking water office has been designated to provide you assistance.

Some states have programs to analyze individual household water supplies at modest cost. In states that do not have such programs, the designated agency should be able to refer you to a commercial lab which will typically do the job for approximately $20 to $35 per sample. We expect more and more laboratories to obtain the special equipment needed and begin offering testing services.

You may be asked to take one or two samples of your household water and send them to the laboratory. Some states and private companies now provide test kits for this purpose. The way a water sample is collected is very important to obtaining a true measurement of the radon level. Generally, you should collect the sample in such a manner that as little radon as possible is lost to the air. Read and carefully follow the sampling directions provided by the testing lab.

Procedures for testing radon levels in household water have been evolving. It now appears that sufficient accuracy can be achieved by using a small vial to obtain a sample of water from an indoor faucet. It is important that there is no aerator on the faucet, that cold water is running for about 10 minutes before the sample is taken, that

during the sampling the water is run slowly, that no air bubbles get into the sample, and that the vial is capped as quickly as possible and returned promptly to the testing lab.

Another technique is to place an alpha track detector in the toilet tank for a specified period of time. The detector comes attached to the inside of a little cup that is inverted on the surface of the water. When the toilet is flushed, radon is released by the flow of water. The amount released is measured by the detector, which is usually left in place for several months. The detector is sent to a laboratory for analysis.

High radon levels in the household water of other members of your community is a good reason to suspect that your home has a waterborne radon problem. (This is not an absolute indicator; at least one well has been discovered with a radon level over 75 times higher than another well only 50 feet away.) If your indoor radon levels are found to be slightly above 4 pCi/L and you are unsure whether your household water is a significant contributor, your state radiation health agency and some testing companies may have a continuous radon monitor that can indicate indoor radon levels before, during, and after water usage.

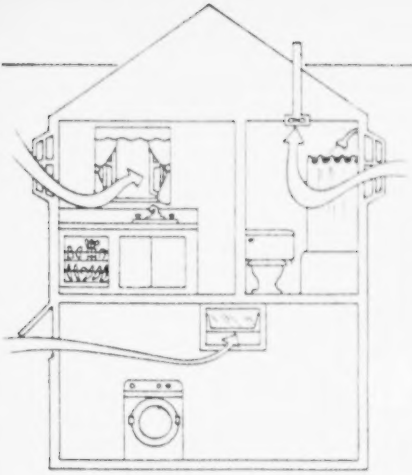
When having your well water analyzed for radon, you might want to consider having the water analyzed for uranium and radium, two other naturally-occurring radioactive elements of health concern. Uranium and radium are usually not found in high concentrations with radon, but in a few areas they are. Before spending the additional money for these analyses, check with your designated state agency to find out whether either uranium or radium is being found in the ground water in your area. If they are being found in your area, the first test you should have done is called a "gross alpha analysis." Depending on the results of that test, analyses specifically designed to measure levels of uranium and radium may be warranted.

Use a faucet with no aerator or be sure to remove aerator from faucet before taking sample.

Control Methods

If initial water test(s) indicate you may have a radon problem, you should do some follow-up testing to verify the results. If these tests show a substantial portion of the radon in the air in your home probably originates in your household water supply, you should consider taking some action. In general, you have two choices: to remove the radon from the air after it has left the water, or to remove the radon from the water before it reaches the indoor air.

In many cases, good ventilation of bathrooms, laundry, and kitchen may be adequate to prevent the buildup of radon in your home. Ventilation during periods of water use is particularly important. If ventilation is used, care must be taken to operate vents and fans in ways that avoid



The cross-ventilation of household areas where water is heated or aerated can remove radon. Care must be taken to avoid depressurizing the house.

depressurizing the house, which could draw in radon from the soil. However, ventilation may prove impractical in cold weather. More information about ventilation techniques can be found in the EPA booklet *Radon Reduction Methods*.

There are several ways and different types of devices to remove radon from water before the water is used in the home. The simplest way is to store the water until most of the radon has gone through its natural radiation decay process. However, storage is not practical for the typical home because several days are needed for the radon to decay, and that calls for a very large storage tank.

Other removal methods are based on the natural tendency of radon to be released when water is exposed to air. Home aeration systems spray the water through an air-filled chamber and use a fan to move the radon-contaminated air out of the house. Presently, home aeration devices are not readily available or widely used; therefore, they have not been extensively tested or evaluated.

Devices which use granular activated carbon (GAC) to remove radon from water are presently the least costly for a single home using its own well and, to date, are the most extensively tested and used. Consequently, the GAC method is the only one described in detail in this booklet. The other removal methods mentioned should not be entirely discounted, however. Home aeration systems, in particular, could well compete favorably with GAC in the future.

How GAC Works

Some impurities in water, primarily organic contaminants but also including dissolved radon, tend to become attached to activated carbon particles. If enough granular activated carbon is contained in a tank through which the household water flows, up to 99 percent of the waterborne radon can be captured. Because of the potentially high collection efficiency for radon and other radioactive elements (especially uranium), the GAC can produce an exposure and disposal problem due to a buildup of radioactivity.

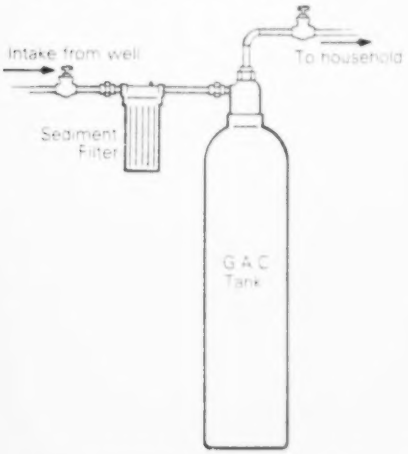
The GAC Tank

A GAC tank designed for radon removal is often made of fiberglass and is similar in appearance to a water softener tank. It is located after the pressure tank in the household water system and is usually located in the basement or other out-of-the-way place. The tank treats all the water used in the home. (Small carbon filters—those attached to kitchen faucets or placed under the sink—are not of adequate size and are ineffective in reducing the level of radon in household air.)

If GAC is used to treat water with high levels of bacteria, the water from the GAC bed will generally have

more bacteria in it than the untreated water. Research to date has not shown the increase in bacteria level to be a health problem. However, because GAC does support bacterial growth, GAC systems for radon removal should not be used to treat water which is microbiologically unsafe or water of unknown biological quality without adequate disinfection.

The ability of GAC to remove radon is affected by the level of radon in the well water, the amount of water used per day, and the type and amount of other contaminants in the water. Experience so far indicates that a typical GAC tank that holds one-and-one-half to two cubic feet of carbon can easily serve a family of four. Properly designed and installed, it should be able to reduce a waterborne radon level of 100,000 pCi/L down to a level of 10,000 pCi/L. A three-cubic-foot unit can handle as much as 250 gallons of water per day and bring down the radon level from above 1,000,000 pCi/L to less than 500 pCi/L.



Typical GAC (Granular Activated Carbon) installation.

Because GAC is a very fine material, a bed of it will filter out many small particles such as iron and other sediments in the water. If the bed is not protected with a prefilter installed upstream in the water system (that is, between the well and the GAC unit), the GAC bed will eventually clog and the flow of water will be reduced. Backwashing (reversing the flow of water through the GAC unit) will remove the particles from the system. It is, however, detrimental to the GAC process because it mixes up the carbon in the tank, temporarily reducing the effectiveness of the GAC in removing radon from the water. Special note: GAC units with automatic backwashing should be avoided.

All GAC units should have a prefilter to protect the bed, either a replaceable cartridge type or a permanent, backwashable type that contains a material such as sand. The frequency for changing a replaceable cartridge filter or for backwashing a permanent filter depends on the quality of the well water. Some filter systems may be equipped with pressure gauges to determine when to change a replaceable filter or to backwash a permanent filter. Instructions provided with the filter should be followed carefully.

Prefilters, properly maintained, will remove many small particles from the water and limit the need to backwash a GAC unit to once a year, or once every two years, or as needed to prevent clogging.

Maintenance

GAC devices are quite simple. They require no mechanical or electrical controls and are installed in-line under pressure. Because of their simplicity and large capacity for radon removal, GAC systems are easy to operate and maintain and should last many years. The only routine maintenance required—depending on

the prefilter system selected—is replacement of the prefilter cartridge or backwashing the permanent prefilter. Should the GAC clog to a degree that backwashing does not correct, or should it build up radioactivity to an unacceptable level, you should replace the GAC. If you plan to do so, read the section on disposal of GAC that follows.

Follow-up

To be certain the GAC system is working, you should have your treated water tested shortly after the system is installed. Follow-up testing is recommended every year to confirm that the system continues to perform effectively. Annual maintenance and operating costs of the system are essentially limited to the cost of replacement prefilter cartridges and the cost of testing water samples.

Cost

Typical GAC units designed for radon removal range in price from $650 to $1,000, depending upon vessel size and the type of GAC used. Adding the cost of installation and the sediment filter brings the total cost to between $800 and $1,200. For the vast majority of high-radon wells—which are below 200,000 pCi/L—the total installed cost should be under $1,200.

Radiation from Tank

GAC has an essentially unlimited capacity for radon removal because radon decays into other radioactive elements as the radon is held in the GAC. During the decay process, which occurs while the tank is in use and afterwards, radiation is given off from the tank. You should not open the tank during this period. The total amount of radiation is related to the level of radon and other radioactive materials in the water supply and the amount of water used. Higher radon levels, more water usage, extended use, and the presence of other radioactive contaminants can also lead to the buildup of long-lived radioactive substances on the GAC. The significance of this possible buildup is being studied.

The placement of the GAC unit is very important since it can cause direct radiation exposure to you and your family. You should place it in an area that minimizes human proximity—possibly outside the home, if that is feasible. Radiation is highest at the surface of the tank and decreases with distance. Shielding the tank with a dense material such as concrete, lead, or even water can reduce the radiation level but will add to the total cost of the system. A knowledgeable, experienced dealer should be able to advise you about proper tank location and shielding needs.

If the waterborne radon level is higher than 200,000 pCi/L, the GAC unit should be placed outside the home—in a pump house, for example—to assure safety, although it is possible that shielding could provide adequate protection indoors.

Background gamma radiation varies around the country, with the average being about 10 microroentgens per hour. While the federal government has not established a suggested limit for radiation levels in living areas, it is desirable to limit radiation from the GAC tank to as close to the background level as is feasible. Some experienced dealers, or your state or local radiation health offices, may have survey meters to measure the level of radiation around your tank. You should consult your state or local radiation health office about the level of radiation above which they advise using shielding. Types of shielding were mentioned earlier.

Disposal of GAC

During operation, the GAC bed will accumulate radon decay products. Eventually, the GAC will need to be replaced, and you will need to dispose of the old GAC. Some states do not want used GAC material to be thrown away in an uncontrolled manner and have established guidelines for proper disposal. When the time comes for disposal of GAC material, you should place the unit in an isolated area for one month to allow the short-lived radiation on the GAC to decay. This may not, however, adequately deal with the longer-lived radioactive substances polonium-210 and lead-210. You should check with the equipment dealer or state radiation protection office about the proper way to dispose of the used GAC.

Getting The Work Done

Your state's designated agency may be able to provide you with a list of dealers or contractors who can sell and install the proper unit for your needs. Unfortunately, since the need for removing radon from the water of some households has only recently been recognized, there are few people with much experience in the field. Therefore, it is important that you exercise care in hiring a reputable company to select, install, and monitor any radon reduction device.

Sources of Information

If you would like further information or explanation about any of the points mentioned in this booklet, you should contact your state radon program office listed at the end of this booklet and ask for your designated state agency.

If you have difficulty obtaining needed information, you may call your EPA regional office, listed at the end of this booklet. EPA's radiation program staff will be happy to assist you.

EPA Regional Offices

EPA Region 1
JFK Federal Building
Boston, MA 02203
(617) 565-3234

EPA Region 2
(2AIR:RAD)
26 Federal Plaza
New York, NY 10278
(212) 264-4418

Region 3 (3AH14)
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-4084

EPA Region 4
345 Courtland Street, N.E.
Atlanta, GA 30365
(404) 347-2904

EPA Region 5 (5AR26)
230 South Dearborn Street
Chicago, IL 60604
(312) 886-6165

EPA Region 6 (6T-AS)
1445 Ross Avenue
Dallas, TX 75202-2733
(214) 655-7208

EPA Region 7
726 Minnesota Avenue
Kansas City, KS 66101
(913) 236-2893

EPA Region 8
(8HWM-RP)
999 18th Street
One Denver Place, Suite 1300
Denver, CO 80202-2413
(303) 293-1648

EPA Region 9 (A-3)
215 Fremont Street
San Francisco, CA 94105
(415) 974-8378

EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
(206) 442-7660

State–EPA Region

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Massachusetts	1
Michigan	5
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Oklahoma	6
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Pennsylvania	3
Rhode Island	1
South Carolina	4
South Dakota	8
Tennessee	4
Texas	6
Utah	8
Vermont	1
Virginia	3
Washington	10
West Virginia	3
Wisconsin	5
Wyoming	8

State Radon Contacts

Alabama
Radiological Health Branch
Alabama Department of Public Health
State Office Building
Montgomery, AL 36130
(205) 261-5313

Alaska
Alaska Department of Health and Social Services
P.O. Box H-06F
Juneau, AK 99811-0613
(907) 465-3019

Arizona
Arizona Radiation Regulatory Agency
4814 South 40th Street
Phoenix, AZ 85040
(602) 255-4845

Arkansas
Division of Radiation Control and Emergency Management
Arkansas Department of Health
4815 W. Markham Street
Little Rock, AR 72205-3867
(501) 661-2301

California
Indoor Quality Program
California Department of Health Services
2151 Berkeley Way
Berkeley, CA 94704
(415) 540-2134

Colorado
Radiation Control Division
Colorado Department of Health
4210 East 11th Avenue
Denver, CO 80220
(303) 331-4812

Connecticut
Connecticut Department of Health Services
Toxic Hazards Section
150 Washington Street
Hartford, CT 06106
(203) 566-8167

Delaware
Division of Public Health
Delaware Bureau of Environmental Health
P.O. Box 637
Dover, DE 19903
(302) 736-4731

District of Columbia
DC Department of Consumer and Regulatory Affairs
614 H Street, NW, Room 1014
Washington, DC 20001
(202) 727-7728

Florida
Florida Office of Radiation Control
Building 18, Sunland Center
P.O. Box 15490
Orlando, FL 32858
(305) 297-2095

Georgia
Georgia Department of Natural Resources
Environmental Protection Division
205 Butler Street, SE
Floyd Towers East, Suite 1166
Atlanta, GA 30334
(404) 656-6905

Hawaii
Environmental Protection and Health Services Division
Hawaii Department of Health
591 Ala Moana Boulevard
Honolulu, HI 96813
(808) 548-4383

Idaho
Radiation Control Section
Idaho Department of Health and Welfare
Statehouse Mail
Boise, ID 83720
(208) 334-5879

Illinois
Illinois Department of Nuclear Safety
Office of Environmental Safety
1035 Outer Park Drive
Springfield, IL 62704
(217) 546-8100 or (800) 225-1245 (in State)

Indiana
Division of Industrial Hygiene and Radiological Health
Indiana State Board of Health
1330 W. Michigan Street, P.O. Box 1964
Indianapolis, IN 46206-1964
(317) 633-0153

Iowa
Bureau of Environmental Health
Iowa Department of Public Health
Lucas State Office Building
Des Moines, IA 50319-0075
(515) 281-7781

Kansas
Kansas Department of Health and Environment
Forbes Field, Building 321
Topeka, KS 66620-0110
(913) 862-9360 Ext. 288

Kentucky
Radiation Control Branch
Cabinet for Human Resources
275 East Main Street
Frankfort, KY 40621
(502) 564-3700

Louisiana
Louisiana Nuclear Energy Division
P.O. Box 14690
Baton Rouge, LA 70898-4690
(504) 925-4518

Maine
Division of Health Engineering
Maine Department of Human Services
State House Station 10
Augusta, ME 04333
(207) 289-3826

Maryland
Radiation Control
Department of the Environment
7th Floor Mailroom
201 W. Preston Street
Baltimore, MD 21201
(301) 333-3130 or (800) 872-3666

Massachusetts
Radiation Control Program
Massachusetts Department of Public Health
23 Service Center
North Hampton, MA 01060
(413) 586-7525 or (617) 727-6214 (Boston)

Michigan
Michigan Department of Public Health
Division of Radiological Health
3500 North Logan, P.O. Box 30035
Lansing, MI 48909
(517) 335-8190

Minnesota
Section of Radiation Control
Minnesota Department of Health
P.O. Box 9441
717 SE Delaware Street
Minneapolis, MN 55440
(612) 623-5350 or (800) 652-9747

Mississippi
Division of Radiological Health
Mississippi Department of Health
P.O. Box 1700
Jackson, MS 39215-1700
(601) 354-6657

Missouri
Bureau of Radiological Health
Missouri Deparment of Health
1730 E. Elm, P.O. Box 570
Jefferson City, MO 65102
(314) 751-6083

Montana
Occupational Health Bureau
Montana Department of Health and Environmental Sciences
Cogswell Building A113
Helena, MT 59620
(406) 444-3671

Nebraska
Division of Radiological Health
Nebraska Department of Health
301 Centennial Mall South
P.O. Box 95007
Lincoln, NE 68509
(402) 471-2168

Nevada
Radiological Health Section
Health Division
Nevada Department of Human Resources
505 East King Street, Room 202
Carson City, NV 89710
(702) 885-5394

New Hampshire
New Hampshire Radiological Health Program
Health and Welfare Building
6 Hazen Drive
Concord, NH 03301-6527
(603) 271-4588

New Jersey
New Jersey Department of Environmental Protection
380 Scotch Road, CN-411
Trenton, NJ 08625
(609) 530-4000/4001 or
(800) 648-0394 (in State)
or
(201) 879-2062 (N. NJ Radon Field Office)

New Mexico
Surveillance Monitoring Section
New Mexico Radiation Protection Bureau
P.O. Box 968
Santa Fe, NM 87504-0968
(505) 827-2957

New York
Bureau of Environmental Radiation Protection
New York State Health Department
Empire State Plaza, Corning Tower
Albany, NY 12237
(518) 473-3613 or
(800) 458-1158 (in State)
or
(800) 342-3722 (NY Energy Research & Development Authority)

N. Carolina
Radiation Protection Section
North Carolina Department of Human Resources
701 Barbour Drive
Raleigh, NC 27603-2008
(919) 733-4283

N. Dakota
Division of Environmental Engineering
North Dakota State Department of Health & Consolidated Laboratories
Missouri Office Building
1200 Missouri Avenue, Room 304
P.O. Box 5520
Bismarck, ND 58502-5520
(701) 224-2348

Ohio
Radiological Health Program
Ohio Department of Health
1224 Kinnear Road
Columbus, OH 43212
(614) 481-5800 or
(800) 523-4439 (in Ohio only)

Oklahoma
Radiation and Special Hazards Service
Oklahoma State Dept. of Health
P.O. Box 53551
Oklahoma City, OK 73152
(405) 271-5221

Oregon
Oregon State Health Department
1400 S.W. 5th Avenue
Portland, OR 97201
(503) 229-5797

Pennsylvania
Bureau of Radiation Protection
Pennsylvania Department of Environmental Resources
P.O. Box 2063
Harrisburg, PA 17120
(717) 787-2480

Puerto Rico
Puerto Rico Radiological Health Division
G.P.O. Call Box 70184
Rio Piedras, PR 00936
(809) 767-3563

Rhode Island
Division of Occupational Health and Radiological Control
Rhode Island Department of Health
206 Cannon Bldg.
75 Davis Street
Providence, RI 02908
(401) 277-2438

S. Carolina
Bureau of Radiological Health
South Carolina Dept. of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
(803) 734-4700/4631

S. Dakota
Office of Air Quality and Solid Waste
South Dakota Dept. of Water & Natural Resources
Joe Foss Building
Room 217
523 E. Capitol
Pierre, SD 57501-3181
(605) 773-3153

Tennessee
Division of Air Pollution Control
Custom House
701 Broadway
Nashville, TN 37219-5403
(615) 741-4634

Texas
Bureau of Radiation Control
Texas Department of Health
1100 West 49th Street
Austin, TX 78756-3189
(512) 835-7000

Utah
Bureau of Radiation Control
Utah State Department of Health
State Health Department Building
P.O. Box 16690
Salt Lake City, UT 84116-0690
(801) 538-6734

Vermont
Division of Occupational and Radiological Health
Vermont Department of Health
Administration Building
10 Baldwin Street
Montpelier, VT 05602
(802) 828-2886

Virginia
Bureau of Radiological Health
Department of Health
109 Governor Street
Richmond, VA 23219
(804) 786-5932 or (800) 468-0138 (in State)

Washington
Environmental Protection Section
Washington Office of Radiation Protection
Thurston AirDustrial Center
Building 5, LE-13
Olympia, WA 98504
(206) 753-5962

W. Virginia
Industrial Hygiene Division
West Virginia Department of Health
151 11th Avenue
South Charleston, WV 25303
(304) 348-3526/3427

Wisconsin
Division of Health
Section of Radiation Protection
Wisconsin Dept. of Health and Social Services
5708 Odana Road
Madison, WI 53719
(608) 273-5180

Wyoming
Radiological Health Services
Wyoming Department of Health and Social Services
Hathway Building
4th Floor
Cheyenne, WY 82002-0710
(307) 777-7956